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(54) **BALL SCREW WITH A DUST-PROOF AND LUBRICATING DEVICE**

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USPC **74/89.44**; 74/89.3; 184/19

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USPC 74/89.44, 89.4, 89.3; 184/19, 102; 277/549, 300–311; 384/241
See application file for complete search history.

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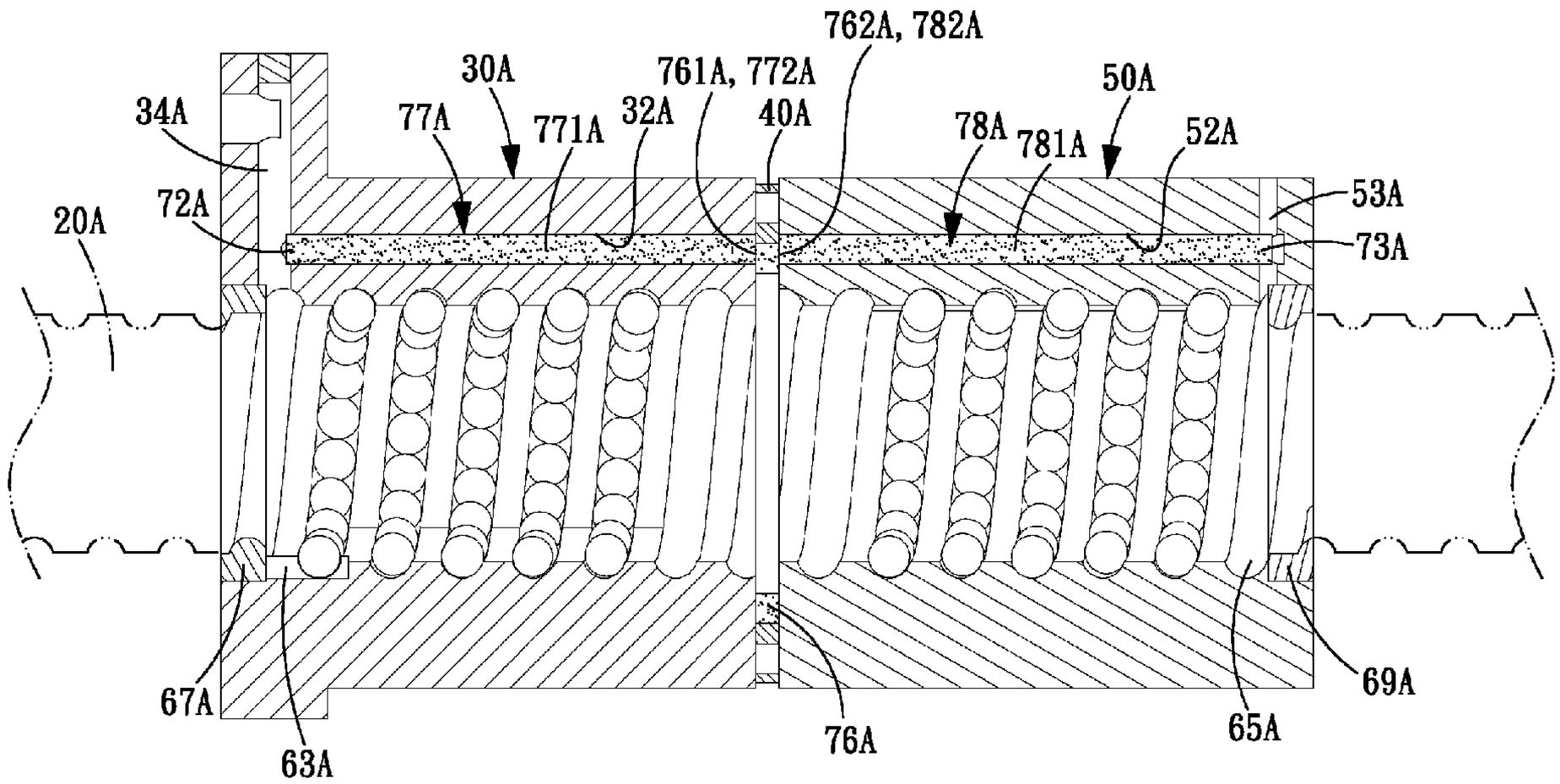
(57) **ABSTRACT**

A ball screw with a dust-proof and lubricating device comprises: a screw, a nut, a plurality of balls, an oil-absorbing member, a return unit, and two dust-proof members. The nut includes an axial oil-guiding hole, a plurality of radial oil holes in communication with the oil-guiding hole and the helical groove of the nut, and an oil-feeding hole in communication with one of the radial oil holes. The oil-absorbing member is disposed in the oil-guiding hole and the radial oil holes. The return unit is disposed in the nut to enable the turning and circulation of the balls. The two dust-proof members are located at both ends of the axial hole. The ball screw can still be lubricated when it is disposed in a vertical position, and the dust-proof and lubricating device which won't add axial length to the nut.

4 Claims, 10 Drawing Sheets



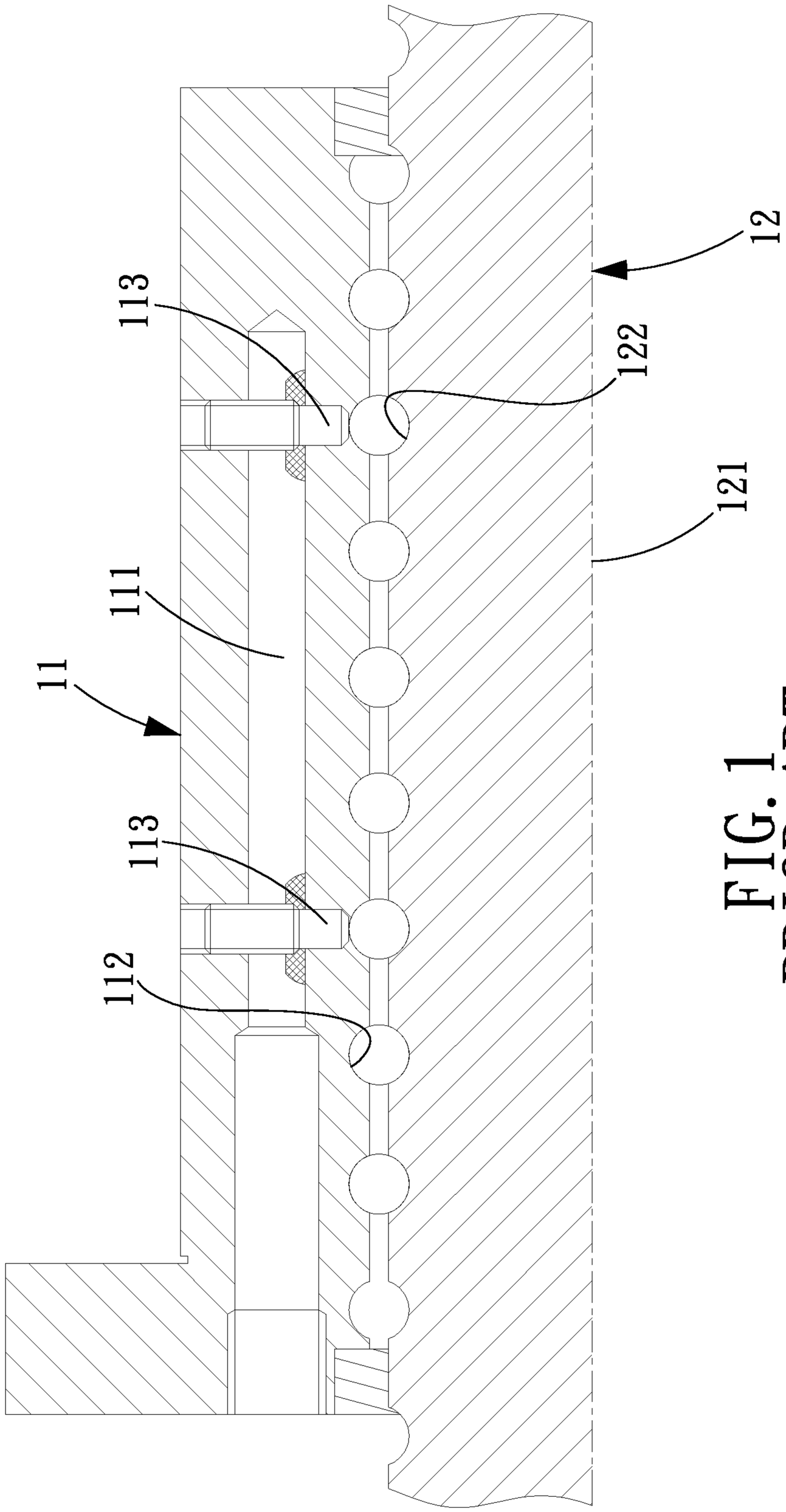


FIG. 1
PRIOR ART

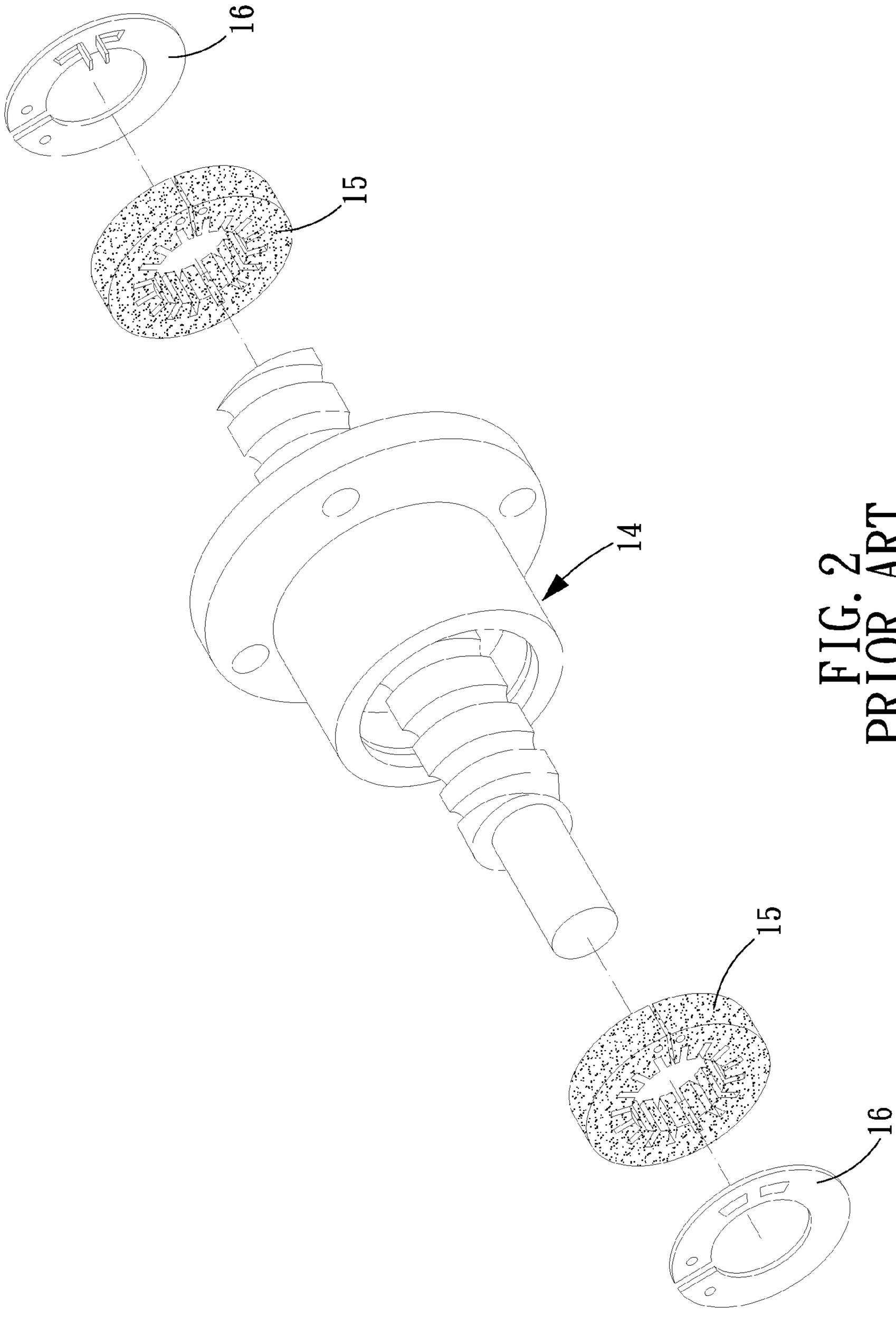


FIG. 2
PRIOR ART

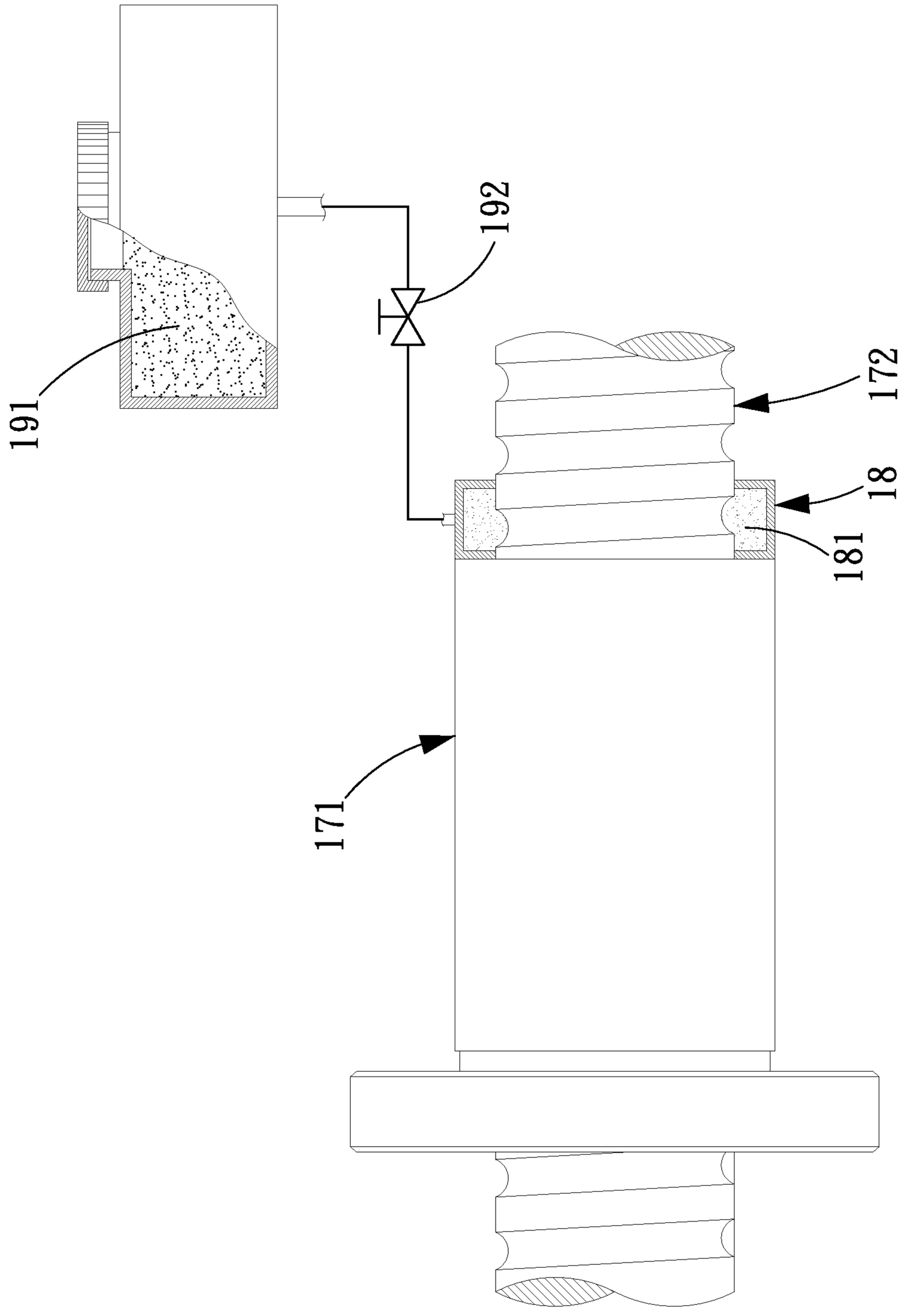


FIG. 3
PRIOR ART

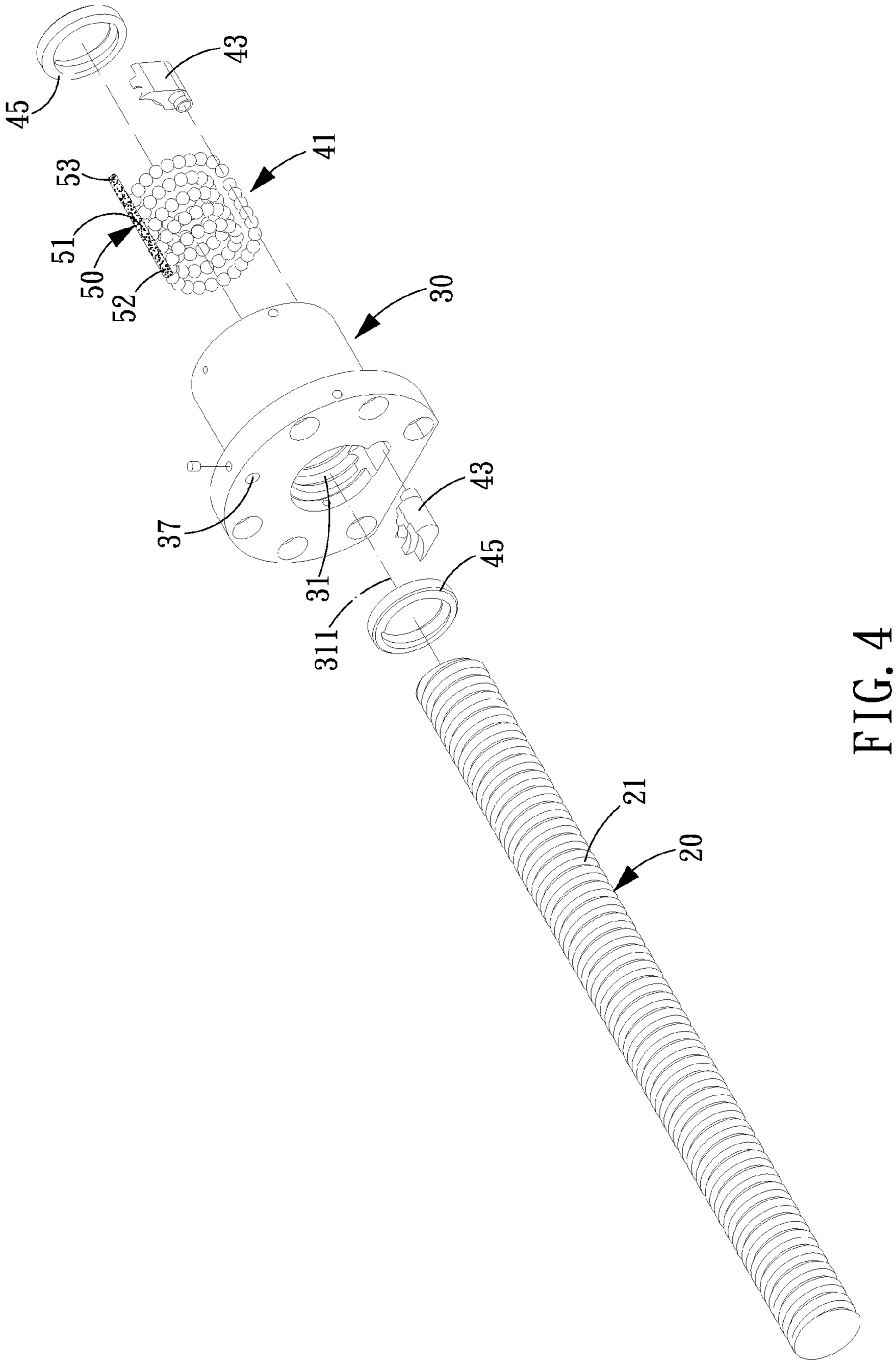


FIG. 4

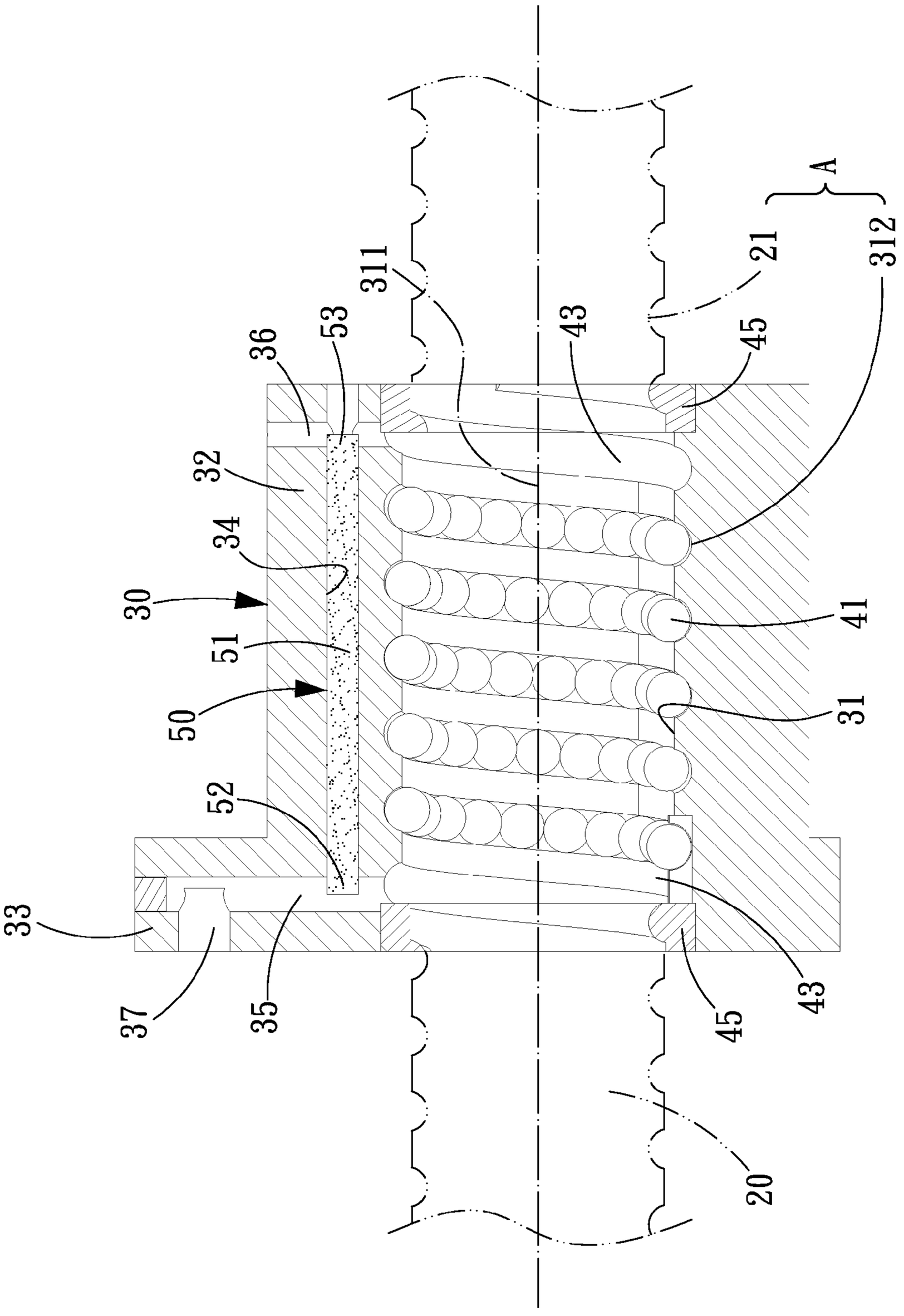


FIG. 5

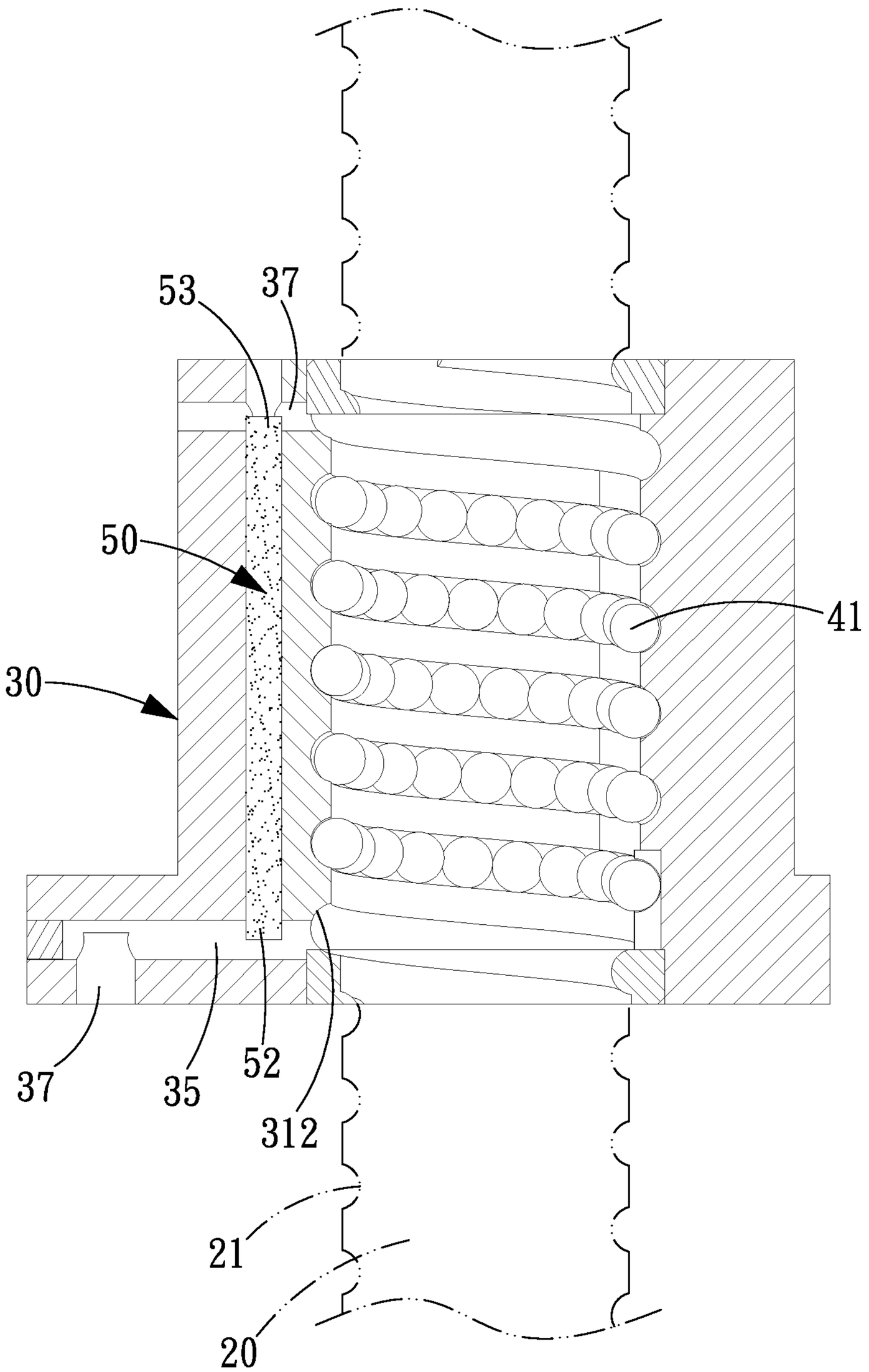


FIG. 6

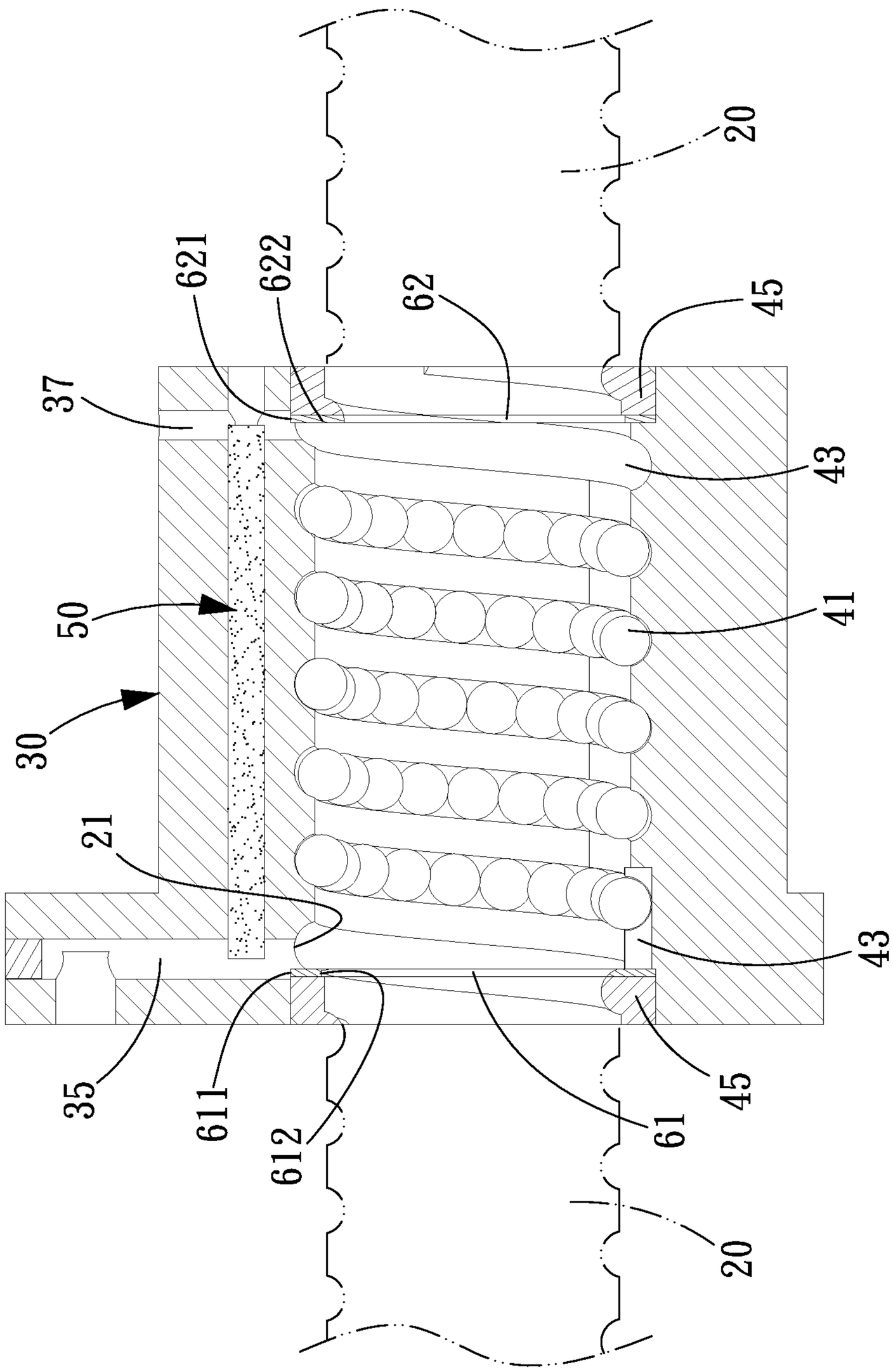


FIG. 7

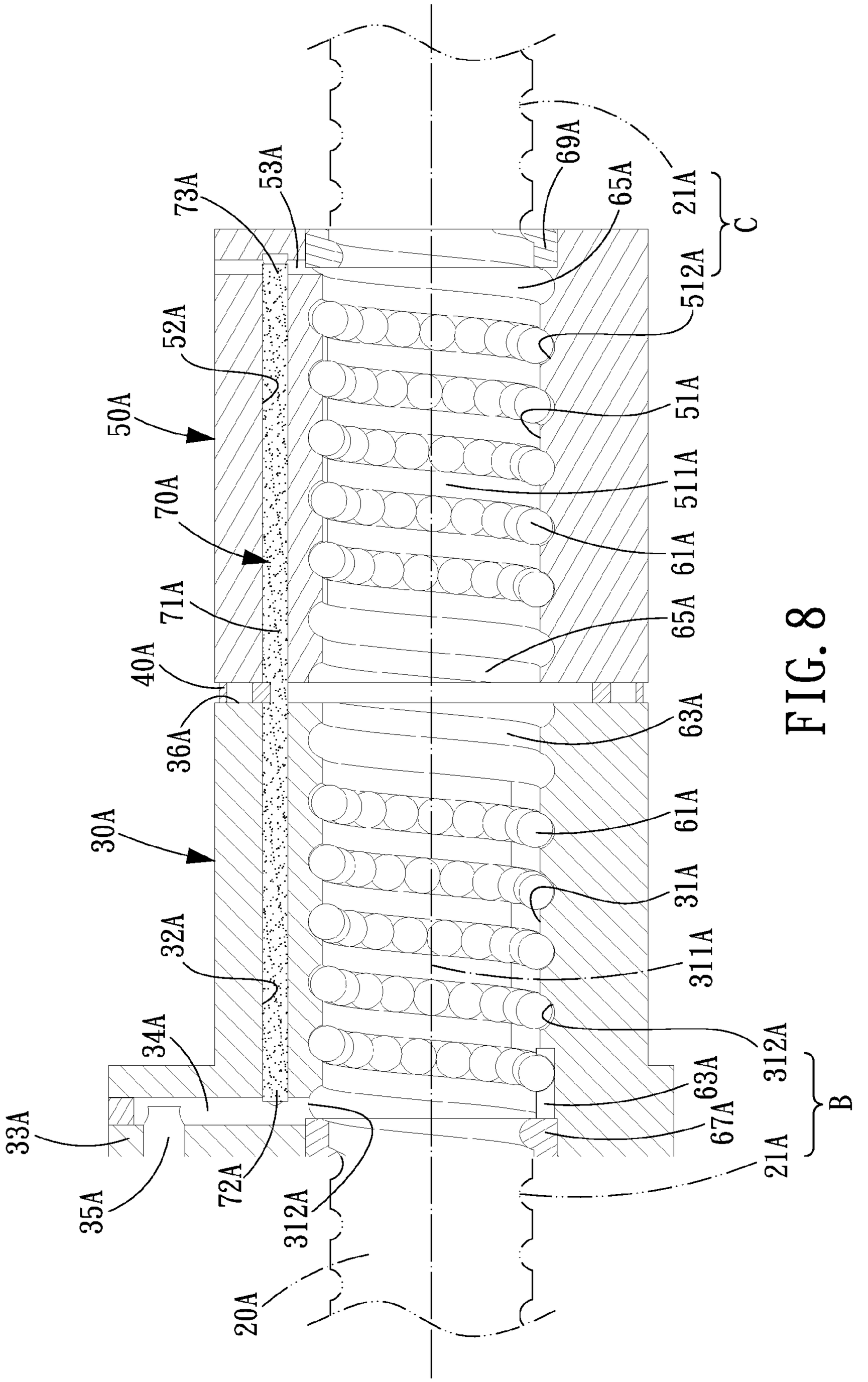

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FIG. 8

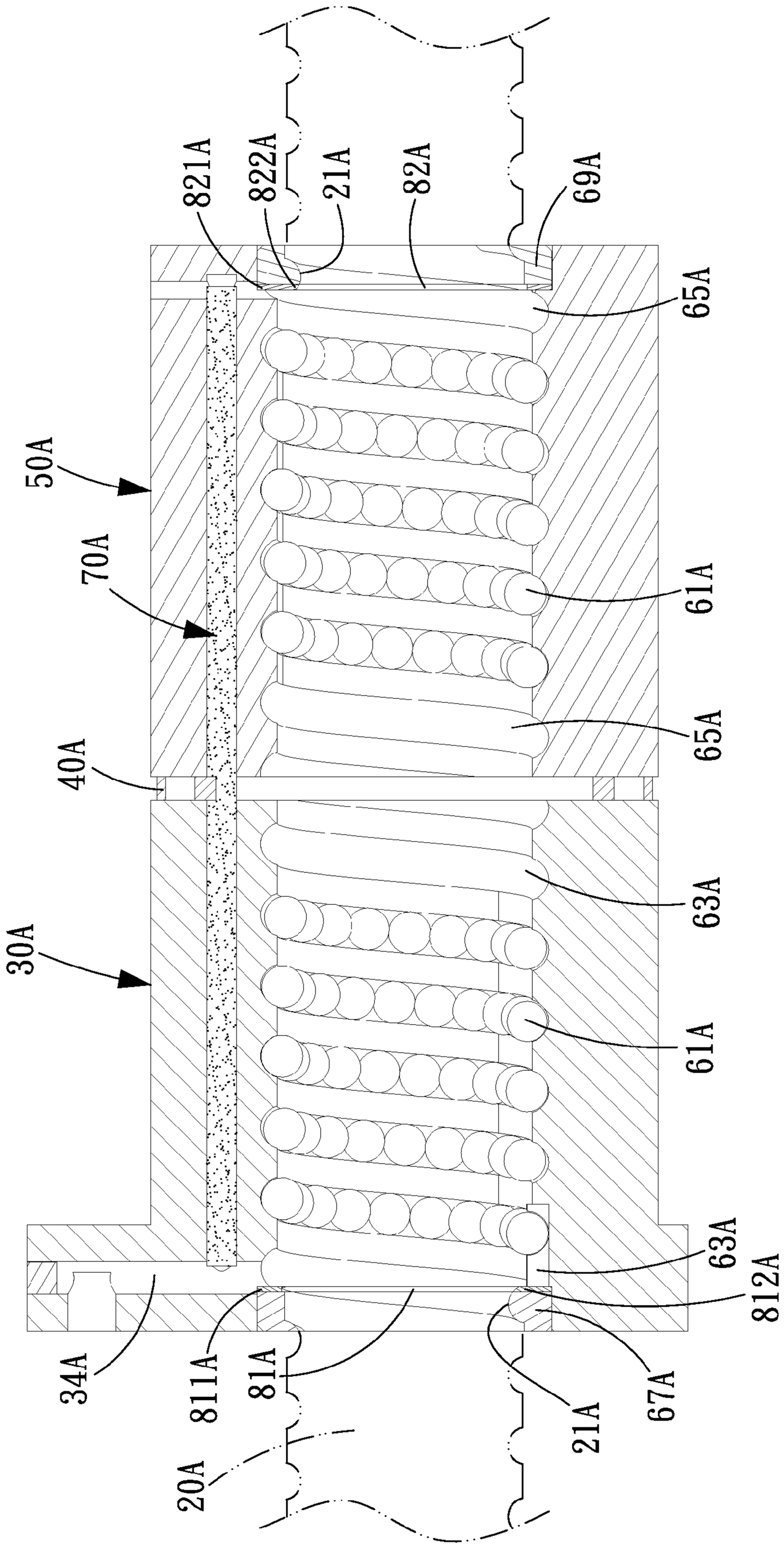
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FIG. 9

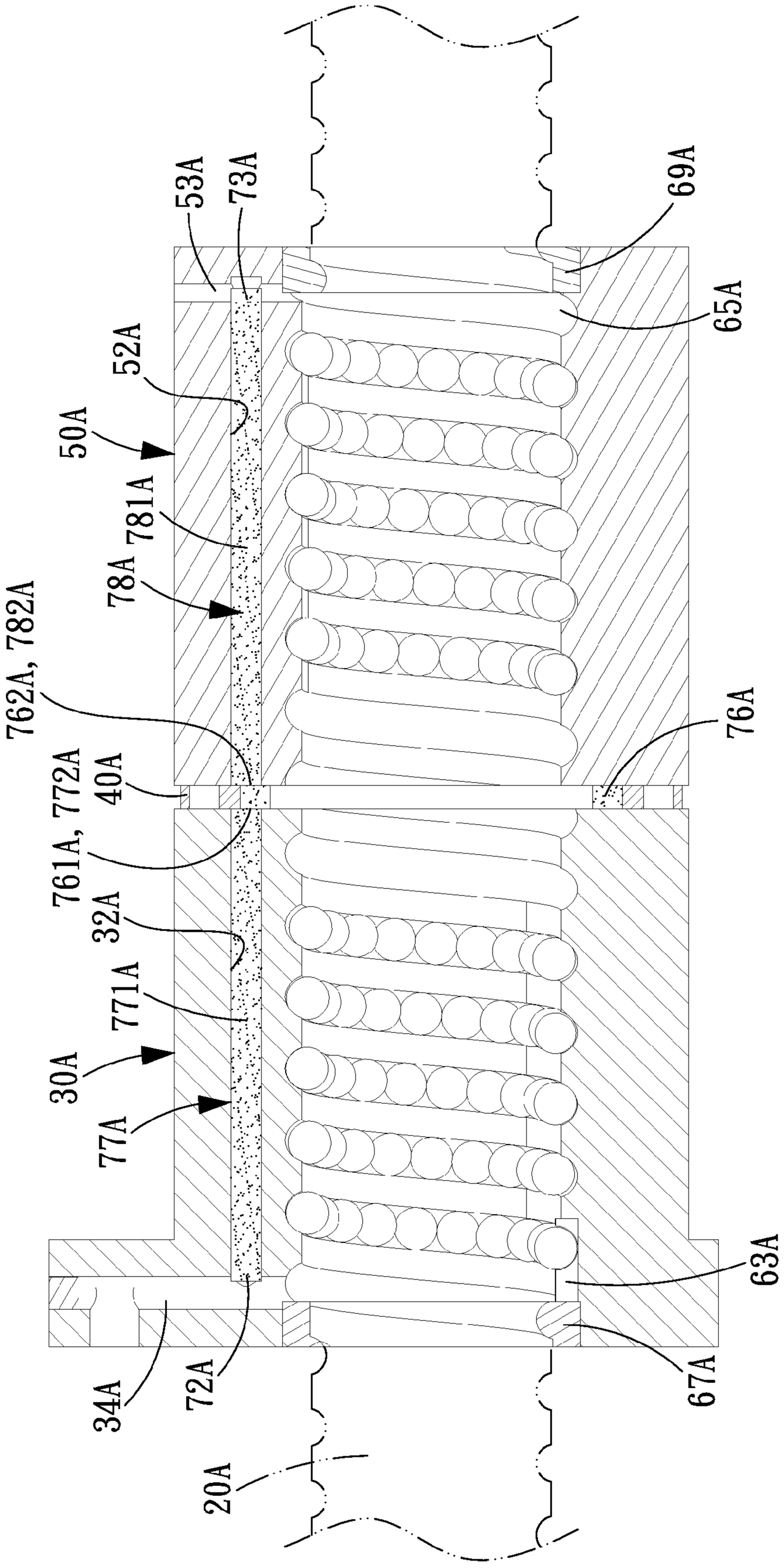
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FIG. 10

BALL SCREW WITH A DUST-PROOF AND LUBRICATING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a ball screw, and more particularly to a ball screw with a dust-proof and lubricating device.

2. Description of the Prior Art

FIG. **1** shows a first type of conventional dust-proof and lubricating device for a ball screw, wherein the nut **11** is formed with a blind hole **111** which is parallel to the axis **121** of the screw **12**, then a plurality of radial oil-feeding holes **113** are formed to communicate the blind hole **111** with the helical groove **112** of the nut **11** or the helical groove **122** of the screw **12**, so that lubricant oil can be fed into the blind hole **111** and flows to the helical groove **112** of the nut **11** via the radial oil-feeding holes **113**. However, when the ball screw is disposed in a vertical position, lubricant oil will be unable to flow through the radial oil-feeding holes **113** into the helical groove **112** of the nut **11** due to the influence of gravity.

FIG. **2** shows a second type of conventional dust-proof and lubricating device for a ball screw, wherein a solid lubricant **15** is disposed at both ends of the nut **14**, and then covered with a dust-proof member **16**, so that the interior of the ball screw can be lubricated by the solid lubricant **15** automatically. The problem is that the solid lubricant **15** needs to be replaced when it is used up, which is inconvenient for the user.

FIG. **3** shows a third type of conventional dust-proof and lubricating device for a ball screw, wherein an oil-storage device **18** is disposed at one end of the nut **171** to define an oil-storage space **181** between the outer surface of the screw **172** and the oil-storage device **18**. Then, an oil tank **191** is disposed outside the ball screw, and a pump **192** is used to draw oil from the oil tank **191** to the oil-storage device **18**. However, arranging the oil-storage device **18** at one end of the nut **171** will add length to the nut **171** while reducing the travel length of the nut.

The present invention has arisen to mitigate and/or obviate the afore-described disadvantages.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a ball screw with a dust-proof and lubricating device, wherein the ball screw can still be lubricated when it is disposed in a vertical position.

Another object of the present invention is to provide a ball screw with a dust-proof and lubricating device, wherein the oil-absorbing member doesn't need to be replaced when the oil is used up.

Yet, another object of the present invention is to provide a ball screw with a dust-proof and lubricating device which won't add axial length to the nut and won't reduce the travel length of the ball screw.

To achieve the above object, a ball screw with a dust-proof and lubricating device comprises: a screw, a nut, a plurality of balls, an oil-absorbing member, a return unit, and two dust-proof members. The screw is formed on an outer surface thereof with an outer helical groove. The nut is mounted on the screw and formed with an axial hole with an axis, an inner helical groove which is formed in an inner surface of the axial hole and cooperates with the outer helical groove of the screw to define a load path, an oil-guiding hole parallel to the axis, a plurality of radial oil holes in communication with the oil-guiding hole and the inner helical groove, and an oil-feeding hole in communication with one of the radial oil holes. The balls roll endlessly in the load path. The oil-absorbing member is disposed in the nut and includes a body disposed in the oil-guiding hole, and one end disposed in the radial oil holes. The return unit is disposed in the nut to enable the turning and circulation of the balls. The two dust-proof members are sleeved on the screw and located at both ends of the axial hole.

Preferably, the nut includes an end portion and a flange portion opposite the end portion, and the oil-guiding hole extends from the end portion to the flange portion of the nut.

Preferably, the number of the radial oil holes is two, one of the radial oil holes is formed in the flange portion, and another one of the radial oil holes is formed in the end portion of the nut.

Preferably, the oil-absorbing member is made of felt or polymer.

Preferably, two oil-absorbing rings which are made of the same material as the oil-absorbing member are mounted on the screw and located between the return unit and the dust-proof members, each of the oil-absorbing rings has an outer annular portion disposed in the radial oil holes and an inner annular portion disposed in the outer helical groove of the screw.

Another embodiment of the ball screw with a dust-proof and lubricating device of the present invention comprises a screw, a first nut, a prestressed unit, a second nut, a plurality of balls, an oil-absorbing member, a first return unit, a second return unit, a first dust-proof member, and a second dust-proof member. The screw is formed on an outer surface thereof with an outer helical groove. The first nut is mounted on the screw, and formed with a first axial hole with a first axis, a first inner helical groove which is formed in an inner surface of the first axial hole and cooperates with the outer helical groove of the screw to define a first load path, a first oil-guiding hole parallel to the first axis, a first radial oil hole in communication with the first oil-guiding hole and the first inner helical groove, and an oil-feeding hole in communication with the first radial oil hole. The prestressed unit is sleeved on the screw and located at an end surface of the first nut. The second nut is mounted on the screw to press against the prestressed unit and includes a second axial hole for insertion of the screw, and the second axial hole includes a second axis which is coaxial to the first axis. The second nut is further formed with a second inner helical groove which is formed on an inner surface of the second axial hole to cooperate with the outer helical grooves of the screw to define a second load path connected to the first load path, a second oil-guiding hole parallel to the second axis, and a second radial oil hole in communication with the second oil-guiding hole and the second inner helical groove. The balls roll endlessly in the first and second load paths. The oil-absorbing member is disposed in the first and second nuts and includes a body disposed in the first and second oil-guiding holes, a first end disposed in the first radial oil hole, and a second end disposed in the second radial oil hole. The first return unit is disposed in the first nut to enable turning and circulation of the balls. The second return unit is disposed in the second nut to enable the turning and circulation of the balls. The first dust-proof member is sleeved on the screw and located at one end of the first axial hole of the first nut. The second dust-proof member is sleeved on the screw and located at one end of the second axial hole of the second nut.

Preferably, the first nut includes a flange portion, and the first radial oil hole formed in the flange portion and the oil-feeding hole are formed in the flange portion.

Preferably, the oil-absorbing member is made of felt or polymer.

Preferably, a first and a second oil-absorbing rings which are made of the same material as the oil-absorbing member are mounted on the screw, the first oil-absorbing ring is located between the first return unit and the first dust-proof members and has a first outer annular portion disposed in the first radial oil hole and a first inner annular portion disposed in the outer helical groove of the screw, the second oil-absorbing ring is located between the second return unit and the second dust-proof member and has a second outer annular portion disposed in the second radial oil hole and a second inner annular portion disposed in the outer helical groove of the screw.

Preferably, the oil-absorbing member includes an oil-absorbing piece, a first oil-absorbing bar, and a second oil-absorbing bar, the oil-absorbing piece includes a first end surface and a second end surface and is disposed between the first and second nuts and pressed by the prestressed unit, the first oil-absorbing bar is disposed in the first nut and includes a first body disposed in the first oil-guiding hole, a first end disposed in the first radial oil hole, and a second end for contacting the first end surface of the oil-absorbing piece, the second oil-absorbing bar is disposed in the second nut and includes a second body disposed in the second oil-guiding hole, a first end disposed in the second radial oil hole, and a second end for contacting the second end surface of the oil-absorbing piece.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross sectional view of a conventional ball screw with a lubricating device;

FIG. **2** is an exploded view of another conventional ball screw with a lubricating device;

FIG. **3** shows another conventional ball screw with a lubricating device;

FIG. **4** is an exploded view of a ball screw with a lubricating device in accordance with a first embodiment of the present invention;

FIG. **5** is a cross sectional view of the ball screw with a lubricating device in accordance with the first embodiment of the present invention;

FIG. **6** is an illustrative view of the ball screw with a lubricating device in accordance with the first embodiment of the present invention, wherein the ball screw is in a vertical position;

FIG. **7** is a cross sectional view of a ball screw with a lubricating device in accordance with a second embodiment of the present invention;

FIG. **8** is a cross sectional view of a ball screw with a lubricating device in accordance with a third embodiment of the present invention;

FIG. **9** is a cross sectional view of a ball screw with a lubricating device in accordance with a fourth embodiment of the present invention; and

FIG. **10** is a cross sectional view of a ball screw with a lubricating device in accordance with a fifth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be clearer from the following description when viewed together with the accompanying drawings, which show, for purpose of illustrations only, the preferred embodiment in accordance with the present invention.

Referring to FIGS. **4** and **5**, a ball screw with a dust-proof and lubricating device in accordance with a first embodiment of the present invention comprises: a screw **20**, a nut **30**, a plurality of balls **41**, an oil-absorbing member **50**, a return unit, and two dust-proof members **45**.

The screw **20** is formed on the outer surface thereof with an outer helical groove **21**.

The nut **30** is mounted on the screw **20**, and formed with an axial hole **31** with an axis **311**, an inner helical groove **312** which is formed in an inner surface of the axial hole **31** and cooperates with the outer helical groove **21** of the screw **20** to define a load path A, an end portion **32**, a flange portion **33** opposite the end portion **32**, an oil-guiding hole **34** which extends from the end portion **32** to the flange portion **33** and is parallel to the axis **311**, a first radial oil hole **35** formed in the flange portion **33** and in communication with the oil-guiding hole **34** and the inner helical groove **312**, a second radial oil hole **36** formed in the end portion **32** and in communication with the oil-guiding hole **34** and the inner helical groove **312**, and an oil-feeding hole **37** formed in the flange portion **33** and in communication with the first radial oil hole **35**.

The balls **41** roll endlessly in the load path A.

The oil-absorbing member **50** is an elongated structure made of felt or polymer disposed in the nut **30** and includes a body **51** disposed in the oil-guiding hole **34**, and two ends **52**, **53** disposed in the first and second radial oil holes **35**, **36** respectively.

The return unit is disposed in the nut **30** to enable the turning and circulation of the balls **41**. In this embodiment, the return unit is two return members **43** which are disposed at both ends of the axial hole **31** of the nut **30**. Or, the return members **43** can also be disposed on the axial outer surface of the nut or disposed in any other conventional manners.

The two dust-proof members **45** are sleeved on the screw **20** and located at both ends of the axial hole **31** to press against the two return members **43**, so as to prevent dust or dirty oil coming into contact with the balls **41** between the screw **20** and the nut **30**.

What mentioned above are the structural relations of the main components of the first embodiment of the present invention, for a better understanding of the operation and assembly of the present invention, please refer to the following description.

As shown in FIG. **5**, when the ball screw of the present invention is disposed in a horizontal position, the oil fed into the oil-feeding hole **37** of the nut **30** will flow through the first radial oil hole **35** to the inner helical grooves **312** of the nut **30** to lubricate the balls **41** and the outer helical groove **21** of the screw **20**. Meanwhile, the end **52** of the oil-absorbing member **50** disposed in the first radial oil hole **35** will draw oil to another end **53** and finally to the second radial oil hole **36**, so that the oil flows to the inner helical groove **312** of the nut **30** through the second radial oil hole **36** to lubricate the balls **41** and the outer helical groove **21** of the screw **20**. Hence, the dust-proof and lubricating device of the present invention is capable of effectively lubricating the interior of the ball screw.

The, the dust-proof and lubricating device of the present invention is located inside the nut **30** to cooperate with the oil-absorbing member **50** which is also disposed inside the nut **30**, such arrangements won't add axial length to the nut **30** and won't reduce the travel length of the ball screw.

Furthermore, the oil-absorbing member **50** inside the nut **30** serves to transport oil, so it doesn't need to be replaced when the oil is used up.

Referring then to FIG. **6**, when the ball screw of the present invention is disposed in a vertical position, the oil fed into the oil-feeding hole **37** of the nut **30** will flow through the first radial oil hole **35** to the inner helical grooves **312** of the nut **30** to lubricate the balls **41** and the outer helical groove **21** of the screw **20**. Meanwhile, the end **52** of the oil-absorbing member **50** disposed in the first radial oil hole **35** will absorb the oil (by capillary action), then the oil will overcome gravity and will be drawn to another end **53** and finally to the second radial oil hole **36**, so that the oil flows to the inner helical groove **312** of the nut **30** through the second radial oil hole **36** to lubricate the balls **41** and the outer helical groove **21** of the screw **20**. Hence, the dust-proof and lubricating device of the present invention is capable of effectively lubricating the interior of the ball screw, even when the ball screw of the present invention is disposed in a vertical position.

Referring to FIG. **7**, a ball screw with a dust-proof and lubricating device in accordance with a second embodiment of the present invention also comprises: a screw **20**, a nut **30**, a plurality of balls **41**, an oil-absorbing member **50**, a return unit, and two dust-proof members **45** and is similar to the first embodiment except that:

On the screw **20** are mounted two oil-absorbing rings **61**, **62** which are made of the same material as the oil-absorbing member **50** and located between the return members **43** and the dust-proof members **45**. The oil-absorbing ring **61** has an outer annular portion **611** disposed in the first radial oil hole **35** and an inner annular portion **612** disposed in the outer helical groove **21** of the screw **20**, and the other oil-absorbing ring **62** has an outer annular portion **621** disposed in the second radial oil hole **36** and an inner annular portion **622** disposed in the outer helical groove **21** of the screw **20**. By such arrangements, oil can be absorbed by the outer annular portions **611**, **621** and will be transported to the outer helical groove **21** of the screw **20** very quickly.

Referring to FIG. **8**, a ball screw with a dust-proof and lubricating device in accordance with a third embodiment of the present invention comprises: a screw **20**A, a first nut **30**A, a prestressed unit **40**A, a second nut **50**A, a plurality of balls **61**A, an oil-absorbing member **70**A, a first return unit, a second return unit, a first dust-proof member **67**A, and a second dust-proof member **69**A.

The screw **20**A is formed on the outer surface thereof with an outer helical groove **21**A.

The first nut **30**A is mounted on the screw **20**A, and formed with a first axial hole **31**A with a first axis **311**A, a first inner helical groove **312**A which is formed in an inner surface of the first axial hole **31**A and cooperates with the outer helical groove **21**A of the screw **20**A to define a first load path B, a first oil-guiding hole **32**A parallel to the first axis **311**A, a flange portion **33**A, a first radial oil hole **34**A formed in the flange portion **33**A and in communication with the first oil-guiding hole **32**A and the first inner helical groove **312**A, and an oil-feeding hole **35**A formed in the flange portion **33**A and in communication with the first radial oil hole **34**A.

The prestressed unit **40**A includes two C-shaped prestressed pieces and is sleeved on the screw **20**A and located at an end surface **36**A of the first nut **30**A. The end surface **36**A is located at one end of the first nut **30**A and the flange portion **33**A is located at another end of the first nut **30**A.

The second nut **50**A is mounted on the screw **20**A to press against the prestressed unit **40**A and includes a second axial hole **51**A for insertion of the screw **20**A, and the second axial hole **51**A has a second axis **511**A which is coaxial to the first axis **311**A. The second nut **50**A is further formed with a second inner helical groove **512**A which is formed on an inner surface of the second axial hole **51**A to cooperate with the outer helical grooves A of the screw **20**A to define a second load path C connected to the first load path B, a second oil-guiding hole **52**A parallel to the second axis **511**A, and a second radial oil hole **53**A in communication with the second oil-guiding hole **52**A and the second inner helical groove **512**A.

The balls **61**A roll endlessly in the first and second load paths B and C.

The oil-absorbing member **70**A is disposed in the first and second nuts **30**A, **50**A and includes a body **71**A disposed in the first and second oil-guiding holes **32**A, **52**A, a first end **72**A disposed in the first radial oil hole **34**A, and a second end **73**A disposed in the second radial oil hole **53**A. In this embodiment, the body **71**A is slightly deformable when pressed by the prestressed unit **40**A.

The first return unit is disposed in the first nut **30**A to enable the turning and circulation of the balls **41**A. In this embodiment, the first return unit is two first return members **63**A which are disposed at both ends of the first axial hole **31**A of the first nut **30**A. Or, the return members **63**A can also be disposed on the axial outer surface of the nut or disposed in any other conventional manners.

The second return unit is disposed in the second nut **50**A to enable the turning and circulation of the balls **41**A. In this embodiment, the second return unit is two second return members **65**A which are disposed at both ends of the second axial hole **51**A of the second nut **50**A. Or, the second return members **65**A can also be disposed on the axial outer surface of the nut or disposed in any other conventional manners.

The first dust-proof member **67**A is sleeved on the screw **20**A and located at one end of the first axial hole **31**A of the first nut **30**A to press against the first return member **63**A.

The second dust-proof member **69**A is sleeved on the screw **20**A and located at one end of the second axial hole **51**A of the second nut **50**A to press against the second return member **65**A.

Referring to FIG. **9**, a ball screw with a dust-proof and lubricating device in accordance with a fourth embodiment of the present invention also comprises: a screw **20**A, a first nut **30**A, a prestressed unit **40**A, a second nut **50**A, a plurality of balls **61**A, an oil-absorbing member **70**A, two first return members **63**A, two second return members **65**A, a first dust-proof member **67**A, and a second dust-proof member **69**A. The ball screw with a dust-proof and lubricating device of the fourth embodiment is similar to the third embodiment, except that:

On the screw **20**A are mounted a first and second oil-absorbing rings **81**A, **82**A which are made of the same material as the oil-absorbing member **70**A. The first oil-absorbing ring **81**A is located between the first return members **63**A and the first dust-proof members **67**A and has a first outer annular portion **811**A disposed in the first radial oil hole **34**A and a first inner annular portion **812**A disposed in the outer helical groove **21**A of the screw **20**A. The second oil-absorbing ring **82**A is located between the second return members **65**A and the second dust-proof members **69**A and has a second outer annular portion **821**A disposed in the second radial oil hole **53**A and a second inner annular portion **822**A disposed in the outer helical groove **21**A of the screw **20**A.

Referring to FIG. **10**, a ball screw with a dust-proof and lubricating device in accordance with a fifth embodiment of the present invention also comprises: a screw **20**A, a first nut **30**A, a prestressed unit **40**A, a second nut **50**A, a plurality of balls **61**A, an oil-absorbing member, two first return members

63A, two second return members 65A, a first dust-proof member 67A, and a second dust-proof member 69A. The ball screw with a dust-proof and lubricating device of the fourth embodiment is similar to the third embodiment, except that:

The oil-absorbing member includes an oil-absorbing piece 76A, a first oil-absorbing bar (which is an elongated structure) 77A, and a second oil-absorbing bar 78A.

The oil-absorbing piece 76A is disposed between the first and second nuts 30A, 50A, pressed by the prestressed unit 40 and include a first end surface 761A and a second end surface 762A.

The first oil-absorbing bar 77A is disposed in the first nut 30A and includes a first body 771A disposed in the first oil-guiding hole 32A, a first end 72A disposed in the first radial oil hole 34A, and a second end 772A for contacting the first end surface 761A of the oil-absorbing piece 76A.

The second oil-absorbing bar 78A is disposed in the second nut 50A and includes a second body 781A disposed in the second oil-guiding hole 52A, a first end 73A disposed in the second radial oil hole 53A, and a second end 782A for contacting the second end surface 762A of the oil-absorbing piece 76A.

What mentioned above are the structural relations of the main components of the first embodiment of the present invention, for a better understanding of the operation and assembly of the present invention, please refer to the following description.

While we have shown and described various embodiments in accordance with the present invention, it is clear to those skilled in the art that further embodiments may be made without departing from the scope of the present invention.

What is claimed is:

1. A ball screw with a dust-proof and lubricating device comprising:

a screw formed on an outer surface thereof with an outer helical groove;

a first nut mounted on the screw, and formed with a first axial hole with a first axis, a first inner helical groove which is formed in an inner surface of the first axial hole and cooperates with the outer helical groove of the screw to define a first load path, a first oil-guiding hole parallel to the first axis, a first radial oil hole in communication with the first oil-guiding hole and the first inner helical groove, and an oil-feeding hole in communication with the first radial oil hole;

a prestressed unit sleeved on the screw and located at an end surface of the first nut;

a second nut mounted on the screw to press against the prestressed unit and including a second axial hole for insertion of the screw, and the second axial hole including a second axis which is coaxial to the first axis, the second nut being further formed with a second inner helical groove which is formed on an inner surface of the second axial hole to cooperate with the outer helical grooves of the screw to define a second load path connected to the first load path, a second oil-guiding hole parallel to the second axis, and a second radial oil hole in communication with the second oil-guiding hole and the second inner helical groove;

a plurality of balls rolling endlessly in the first and second load paths;

an oil-absorbing member disposed in the first and second nuts and including a body disposed in the first and second oil-guiding holes, a first end disposed in the first radial oil hole, and a second end disposed in the second radial oil hole;

at least one first return unit disposed in the first nut to enable turning and circulation of the balls;

at least one second return unit disposed in the second nut to enable turning and circulation of the balls;

a first dust-proof member sleeved on the screw and located at one end of the first axial hole of the first nut; and

a second dust-proof member sleeved on the screw and located at one end of the second axial hole of the second nut.

2. The ball screw with a dust-proof and lubricating device as claimed in claim 1, wherein the first nut includes a flange portion, and the first radial oil hole formed in the flange portion and the oil-feeding hole are formed in the flange portion.

3. The ball screw with a dust-proof and lubricating device as claimed in claim 1, wherein the oil-absorbing member is made of felt or polymer.

4. The ball screw with a dust-proof and lubricating device as claimed in claim 1, wherein the oil-absorbing member includes an oil-absorbing piece, a first oil-absorbing bar, and a second oil-absorbing bar, the oil-absorbing piece includes a first end surface and a second end surface and is disposed between the first and second nuts and pressed by the prestressed unit, the first oil-absorbing bar is disposed in the first nut and includes a first body disposed in the first oil-guiding hole, a first end disposed in the first radial oil hole, and a second end for contacting the first end surface of the oil-absorbing piece, the second oil-absorbing bar is disposed in the second nut and includes a second body disposed in the second oil-guiding hole, a first end disposed in the second radial oil hole, and a second end for contacting the second end surface of the oil-absorbing piece.

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